THE NATURE CONSERVANCY NEWS

March/April 1979

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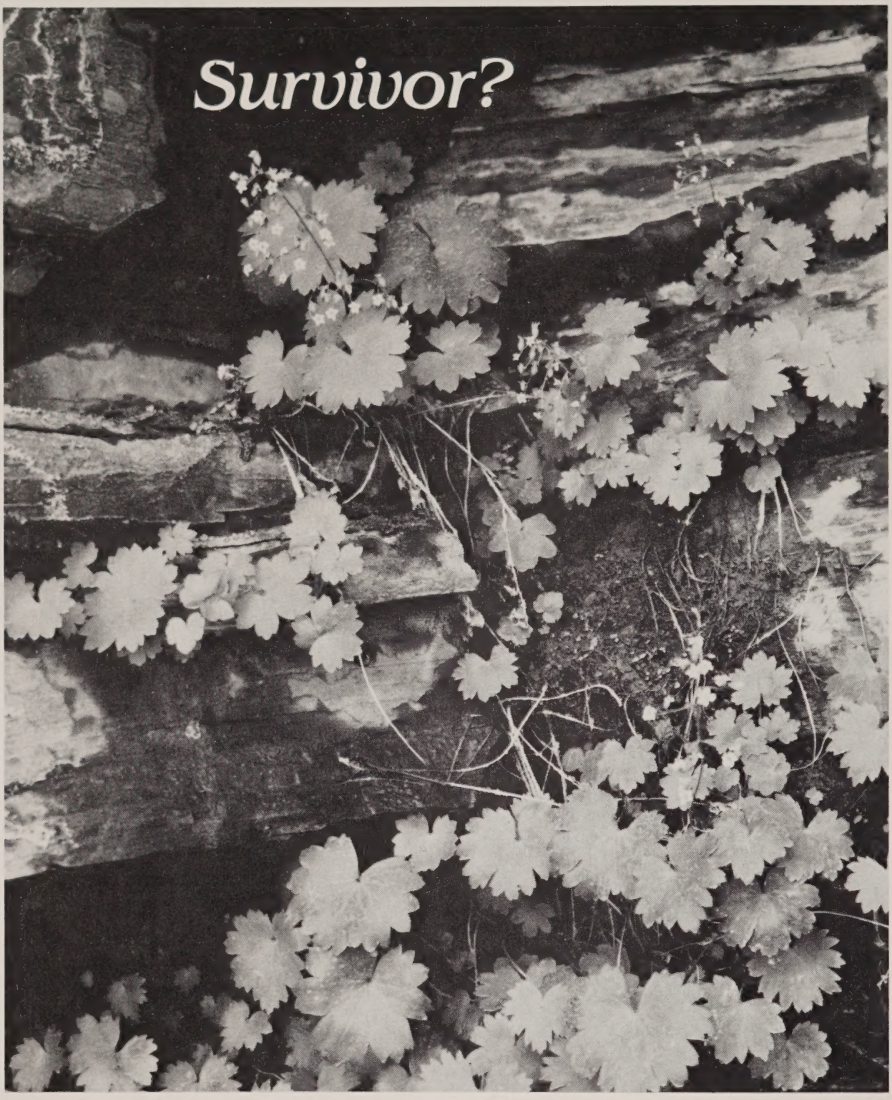
RARE PLANTS



Sullivantia purpusii, a threatened species, grows in moist seep areas of rimrock.

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in a tiny wildflower?

Another life-giving medicine?

The genes for a high yield food?

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THE NATURE CONSERVANCY NEWS

VOLUME 29, NUMBER 2
MARCH/APRIL, 1979

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COVER: Small white lady's slipper. Photo by Jim Brandenburg.

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Plant Rarity
Real and Imagined

by James L. Reveal and C. Rose Broome

People attach a high value to almost anything that is rare. Gold is treasured, hoarded, and even killed for. A painting by a master is valued because of its uniqueness. An object from a foreign land, or from the distant past, is often prized (and priced!) far above another that is indigenous or new. Rarity is a human concept—a condition ascribed by humans to those things they lack in quantity. With characteristic presumption, we quite easily apply the same standards of rarity both to inanimate objects and to entire species of organisms other than ourselves.

A species of tree that is commonplace in China may be considered economically valuable in the marketplace simply because the tree is rare in the Western World and only a few wealthy Occidentals may have it. Such a tree is often guarded and hoarded even as might a fine piece of china or an antique chair. On the other hand, a plant species may be given great value even in its native habitat because it is scarce in nature and in cultivation. Our perception of rarity is largely subjective, often emotional, and too seldom supported by the necessary number of observations to document it. Rarity may be determined by the level of want (demand exceeds supply), but the converse is just as often true—that the desire to possess something no one else has automatically confers value on the object or species.

True biological scarcity is a product of evolutionary processes, both of the plant species and of the habitat it occupies. Since the advent of humans, both types of evolution have been altered by our presence. Some plant species have been favored by our coming. Their competitive ability has been enhanced by human alteration of the habitat and their numbers are on the increase. We call them weeds. Others have been the object of our need or desire, or have simply been in our way. Of this group, some have become scarce because we caused them to be, and we label them "rare."

In general, rarity describes a situation where a species is so infrequently seen, or is found in such a limited area, that we consider it "rare" when compared with other species of a similar character.

What we conceive of as rare is based upon our observations, at a given moment, of the occurrences of an object in that portion of the world with which we interact. The object may or may not be rare in fact, but if our knowledge of it is so limited that we perceive it as rare, then to us it *is* rare. Each person's subjective concept of rarity or abundance, unsupported by all the facts, may lead to disagreement, misunderstanding, and sometimes hasty political and economic decisions.

There are three broad categories into which rare plants may fall, with many intermediate conditions between these. First, a species may be known only from a few individuals scattered over

a large geographic area, say, the eastern United States. Second, a species may be found in small numbers within a population, but with the populations widely scattered in numerous places over its geographic range. Third, the populations may be quite large with abundant numbers of individuals, but there may be very few, or one at the extreme, only those populations in existence.

Plant rarity is a product of a number of factors relating to the actual and potential distribution of a species. For most plants, rarity is a twofold phenomenon, involving both the biology of the species and the ecology of its habitat. In current usage, any action that might further reduce or restrict the numbers or distribution of a species is termed a "threat." Threats may be "natural" factors relating to biological processes, or threats may be factors imposed by people and unrelated to the "natural" evolutionary processes of the plant, or, for that matter, of humans.

It is fashionable among many scientists, as well as lay people, to consider habitat alteration by humans as somehow "unnatural." The "social Darwinists," on the other hand, would argue that *Homo sapiens* is as much a part of the "natural" environment of plant species as the antelope or the rabbit, and that it is "natural" for us to displace other species as we carve out our own niche as a dominant species.

Those who would consider human intervention in the evolution of organisms and habitats as "unnatural" would probably admit, if pressed, that to label all human activity in that way is ridiculous. Our activities become removed from the realm of "natural" only when the activity is not really necessary to our survival as a successful species, but merely to the maintenance of a wasteful and presumably unnecessary standard of living. Since humans can choose *not* to do something, our conscious choice *to* do something to the detriment of another species may be labeled as "unnatural." (The opposing view would label such an action as immoral, perhaps, but perfectly "natural.") Since this distinction between "natural" and "unnatural" threats to the survival of rare species is, then, based on what human beings may choose to do or not to do, it is a useful one.

Plant rarity results naturally in two ways. Progressive extinction may cause a species, which was once widespread and common in the geological past, to become rare. This usually occurs because the plant's genetic system cannot adapt to a changing environment rapidly enough to keep it from losing ground and being replaced by "fitter" species. Or a species may be rare because it evolved as a local, divergent population, then became isolated from the parental species and has been unable to compete aggressively with related species for available resources or space. In

Examples of the three categories into which rare plants may fall: top left, the cardinal flower (Lobelia cardinalis) *is widespread in North America but in small numbers; top right, Holmgren's bluebonnet* (Lupinus holmgrenianus) *is locally common in scattered populations in southwestern Nevada and adjacent California; and above,* Lesquerella tumulosa *is known only from a single white shale outcrop in Kane County, Utah.*

the latter case, the highly specialized or localized species is simply unable to displace other species in the same habitat under the prevailing set of environmental circumstances. This is not to say that such a species does not have the potential to expand its range or distribution, but it can do so only under a different set of conditions. Much as the species in the first instance has been reduced in numbers owing to a changing environment, so too can a rare species expand its range when conditions change. This is what was alluded to above as the "potential" distribution of a species.

Another aspect of rarity deals with the human perception of rarity. For instance, it is always interesting to talk to older naturalists. This or that wildflower was "absolutely everywhere!" These plants were apparently found in the millions, over every hillside for miles; but today there is not a one to be seen. This human perspective is one of the most difficult problems to deal with, for it is often the emotional aspect of rarity, rather then the scientific aspects, that affects political decisions. Although a certain plant may have been locally common—but now has been replaced by concrete and swimming pools—it does not mean that the species is biologically rare.

Orchids are always about to go extinct. Years ago there must have been orchids everywhere if one is to believe all the stories told about them. The perception is that the species are now rare because orchids are not as commonly seen as they were in the past. No question about it, that is true. But, this does not mean that *all* orchids are rare. A given orchid may be more limited in its range, found in more remote places, and (fortunately) subjected to less collecting by orchid lovers—all as a result of human pressures. But it can still be a vigorous species for an orchid. Compared to the past, when there were fewer people and less outright habitat destruction, orchids could be gathered in large numbers without an immediately perceptible decline in their numbers. However, as the demand for orchids continued, and as more and more collectors came and gathered in the "good" sites, the numbers of individuals declined and the species became harder to obtain. Prices escalated and it became economically worthwhile to search even harder for them. Now rare, an orchid species is even more valuable and sought after. Thus our concern today for species of orchids. In some instances the species have truly become exceedingly rare and are threatened with human-caused extinction, but more often the species is not rare, just harder to find. Yet because we perceived the species to have been common in the past, we declare it rare today because we can't find it as easily.

"The forced extinction of any species by humans is inexcusable when the survival of that species does not threaten our own survival. Such a loss of genetic material in the life system of our environment can never be replaced. No advanced technology will ever replace an extinct species."

The emotional aspect of rarity applies to relatively few organisms. An emotional response is much more common toward groups of higher vertebrate animals than it is, say, for a spider, a snake, or almost any plant. There may be several thousands of individual grizzly bears, white whales, seals, and the like around the world, and the emotional appeal of these animals brings great concern for their long-term survival. These animals are being decimated by humans; yet, there are thousands of other less attractive animal species whose numbers are in the tens or hundreds, which are facing a degree of threat from people that is far more imminent. Biologically rare plant species by the hundreds are found in the United States, and especially in Hawaii. Yet their ongoing extinction does not evoke the emotional response that an orchid does which has merely gone from "common" to "infrequent," or is now less abundant in one place than it was in the past.

The emotions raised in people by rare plants are the contradiction of rarity. Who cares that some pondweed or saltbush should fall victim to human-caused extinction? Such minor, unimportant species do not raise the emotions, do not cause great organizations to be formed for their protection, or produce a blizzard of letters to Congress. We say we care, but emotionally we can care only for those things that can hold our attention. It is hard to cut down one of the giant Big Trees found in the foothills of the Sierra Nevada; the death of such a monarch is sad even for the person handling the saw.

The crash is deafening; it hurts. That is an emotion. Yet, the truly rare little herb, underfoot, walked on and crushed into extinction by the logger and by the protestors alike—who will notice? That plant will have not made the news or headlines of the papers; only nature will note the contradiction by the loss of a potential source of genetic variability.

In dealing with the preservation of rare plant species, a different attitude toward saving them must be taken. Unlike many of the higher animals, which can to some extent take care of themselves, organisms such as plants *must* have their habitat guaranteed. Plants cannot run away, migrate, or escape a given site when that area is threatened with destruction. The same holds true for many small and inconspicuous animals who, like plants, hold little political or emotional interest. Thus laws are not often written with such sedentary species in mind.

One must also remember that many species of plants have evolved in one particular site and, therefore, become restricted to single or unique habitats. It is not unusual to find a rare species restricted to a single geologic outcrop, a single free-flowing spring, a vernal pool, or an otherwise distinct "island" within an otherwise uniform setting. Gypsum, limestone, serpentine, clays, and other types of soils tend to harbor many rare species that cannot survive on other soil types in the immediate area. Springs and vernal pools, especially in portions of the arid western United States, provide the only sites for numerous rare plants. Sphagnum bogs harbor some of the loveliest rarities in the eastern United States. It is not unusual for such unique sites to be small and restricted so that their physical size consequently restricts the potential range of a species. Finally, as such habitats are often sporadically located within ordinary habitats, the microhabitat is rarely considered when the whole of the area is exploited. In some situations, as with springs and ponds, it is precisely the features of the interesting habitat that cause the exploitation to occur. The capping of springs and the use of pond water for human purposes will often instantly doom the unique organisms associated with such sites. Again we are back to human choices, only this time our choices are all too often made out of ignorance of the biotic consequences. The exploiter rarely knows that unique species are present and that they are absolutely dependent upon these restricted habitats for their survival.

Therefore, the loss of the majority of rare species is typically through ignorance. Few people are aware of such minor organisms as rare plants, especially plants of no particular commercial or horticultural importance. The destruction of habitats, while frequently wanton, is not often out of malice toward any rare organism. This sort of ignorance is tolerable only to an under-educated and ill-informed citizenry.

Most rare, native, wild plants have no known commercial value. This is not to say that simply because a species has no commercial value to us that its survival is unimportant. The forced extinction of any species by humans is inexcusable when the survival of that species does not threaten our own survival. Such a loss of genetic material in the life system of our environment can never be replaced. No advanced technology will ever replace an extinct species. Those plants and animals lost unnecessarily in the past and in the future will only reduce the opportunities for the life system to continue. Evolutionary processes can work only with what is available. Kill off species and eventually the life-sustaining process of evolution will, itself, become impoverished.

The forced extinction of species by humans in the past has robbed future generations of a source of genetic material that might have been useful to them. That some people feel they have a right to do this is a God-like position which will direct the future of the world more severely than any war or event of history. As the paramount species on earth, we must carefully direct our actions to insure the survival of all things that can survive the normal (or "natural") selective pressures of their habitats. Those that cannot should become extinct.

The biosphere has been visited before by great catastrophies, such as ice ages and great periods of excessive temperatures, and plants have survived. These natural events have pitted great forces against the immobile plant and dared it to adjust, to modify, and to survive. But those natural events have given the plant one thing humans rarely offer, and that is time. True, the original species may be lost, but its off-

"Plants are at the base of all food chains, and without plants there could be no life as we know it."

spring, and theirs and theirs, have been permitted to survive, to evolve, to attempt to adjust to the new environmental conditions. Evolutionary processes can deal with fire, with cold, with heat, with aridity, with excessive moisture. But those same processes cannot deal so effectively with the chainsaw, the bulldozer, or pavement. Plants are at the base of all food chains, and without plants there could be no life as we know it. The assassination of that one last individual of a species is a final act. Its unique combination of genes and characteristics the genes manifest can no longer contribute to the evolutionary process. Not only is that individual species lost, but so too are a potential multitude of derivative organisms. How much value does one place upon the future? When that can be determined by an accountant, then we can establish the value of a rare plant. Fortunately, the citizens of the so-called "developed" countries appear ready for a new awareness of the innate worth of any kind of organism that has managed to evolve, to compete, and—up to now at least—to coexist with us. If ordinary people can be aroused to care for all species, then they can be motivated to inform themselves about which of those species are endangered. The professional and amateur naturalists should willingly assume the function of educators to a responsive public.

In North America we are only now attempting to understand the plants and animals that make up our native biota. We can guess which are the rare plants, and we can often determine the general distribution of these species, but often we have little understanding of the interrelationships between many of the rarer species. Recently the Flora North America project (FNA) was revitalized by the Man and Biosphere Program (MAB), a UNESCO program, as a bi-national effort between the U.S. and Canada to produce a conventional compendium of the vascular plants of North America north of Mexico using the traditional methods of floristic botany. Initial funding for the proposed five-volume work is being provided by the National Park Service of the Department of the Interior. The MAB/FNA Program Council plans to coordinate the necessary research to produce a publication of high scientific quality that is also pertinent to national needs.

"How much value does one place upon the future? When that can be determined by an accountant, then we can establish the value of a rare plant."

The Program Council has appointed an Editorial Subcommittee whose function will be to stimulate and coordinate the efforts of the botanical community in the writing of the compendium. Toward this goal, the Subcommittee is currently working on a proposed format for the flora of North America. Initial efforts will be toward the production of a volume treating the monocots (flowering plants that have single-seed leaves, such as grasses and sedges), and a second volume on sympetalous dicots (plants having fused petals and double-seed leaves, such as beans and peanuts). The remaining three volumes, containing chapters on the history of systematic botany in North America, the paleobotanical history of the flora, the geographic significance of the flora, plus the taxonomic treatments of the ferns, fern allies, gymnosperms, and the rest of the dicots, will be produced several years in the future.

Long-term federal funding for the flora project is being explored by the Program Council, chaired by Dr. Peter H. Raven of the Missouri Botanical Garden, in both the United States and Canada. It is hoped that the flora project will be completed by 1990. Unfortunately, with the recent reductions in federal allocations in both the U.S. and Canada, the future of this project is now somewhat in doubt.

Without a compendium of the flora of North America, we will still not know which species of plants are truly rare and which we just think or imagine are rare. Unlike Europe, the Soviet Union, China, and a number of other nations, the U.S. still has no complete understanding of its native flora. With the knowledge we can gain from producing the compendium, combined with other related efforts—such as Interior's Endangered Species Office, the Conservancy's State Heritage Programs, Smithsonian's Office of Biological Information, and the International Union for the Conservation of Nature (IUCN)—we can begin to make rational decisions to conserve and coexist with our rare plants.

James L. Reveal and **C. Rose Broome,** husband and wife, are professors of botany at the University of Maryland, College Park. Reveal is the editor for the proposed flora treating the vascular plants of North America north of Mexico.

Plants for All Seasons: Conservation as if Nature Mattered

by Bruce MacBryde, Botanist
Office of Endangered Species
U.S. Department of the Interior

In 1973, the U.S. Congress recognized that a quiet crisis was occurring across the country and that the government had the responsibility to confront it. Consequently, when the Endangered Species Act was passed at the end of the year, wild plants were included in its protective measures. Naturalists and wildland managers had been aware for some time that vegetation should be conserved, but little attention had been given to the plight of individual plant species that were being affected by human activity. Even most botanists gave either casual or strictly scientific attention to rare plants, rather than evaluating the plants' vulnerability to the increasing threats of an expanding, more demanding human population. Recognizing that the problem was large, and that protection of animals held a considerable lead over plants, the 1973 Endangered Species Act directed the Smithsonian Institution to spend a year reviewing the situation, which resulted in a report on vulnerable native vascular plants (ferns and seed plants).

The Smithsonian's canvass of much of the literature and many botanists confirmed that there is indeed a crisis: in 1977 it estimated that 90 wild plant taxa (species, subspecies, and varieties) might be extinct in 49 states, and another 270 might be lost in Hawaii. Smithsonian researchers ascertained that 839 species of wild plants in the continental states and 646 others in Hawaii are in danger of extinction *now* (these were recommended for *endangered* status). Smithsonian also suspected that an additional 1,211 plants in the continental U.S. and 197 more in Hawaii would go extinct in the foreseeable future if current trends continue (these plants were recommended for *threatened* status). If all the endangered and threatened plants could cry out, what a cacophony: 10.7 percent of the mainland flora and 50.6 percent of the Hawaiian flora have been lost or are disappearing.

The Endangered Species Act of December 1973 —significantly amended in November 1978—is intended to conserve endangered and threatened species in the ecosystems upon which they depend, unless an exemption allows an outweighing alternative use of the land for people. The Act provides legal definitions of the following entities or terms: plant, species, endangered, threatened, critical habitat, and conservation. These definitions are comprehensive so that *any* plant—from fungi and algae, mosses and ferns, to conifers and flowering plants—can be protected if it is in danger of extinction in any significant portion of its range. However, the Act's definitions do not allow for the protection of just some of a plant's populations. Not only can any vulnerable plant be considered for protection, but the Act also allows any threat to be evaluated in determining whether the plant is in fact in peril and, consequently, should be placed on the federal list of protected species. The land legally designated as a plant species' critical habitat may include sites in which the plant can expand from its current range, if it is determined that expansion is essential for the species' survival. Furthermore, the amended Endangered Species Act encourages restorative management by requiring recovery plans for virtually every listed species. Even when a species has been exempted from full protection, the Act requires that adverse impacts on the species be kept to a minimum and that attempts be made to save affected plants by other means, such as transplantation or propagation.

The steps that the U.S. Fish and Wildlife Service must complete to list officially a species and determine its critical habitat are complex and time-consuming. Recent amendments have made the procedure even lengthier. They require greater efforts to encourage comments from federal, state, and local governments, from the scientific community and the general public, as well as more public meetings and hearings. Fish and Wildlife also must determine critical habitat at the same time the species is listed (unless it is not prudent, as with collected cacti whose locations must be concealed). In addition, the Service must provide an analysis of the economic and other impacts of a critical habitat determination. This analysis could cause part of a critical habitat to be excluded from protection under the Act.

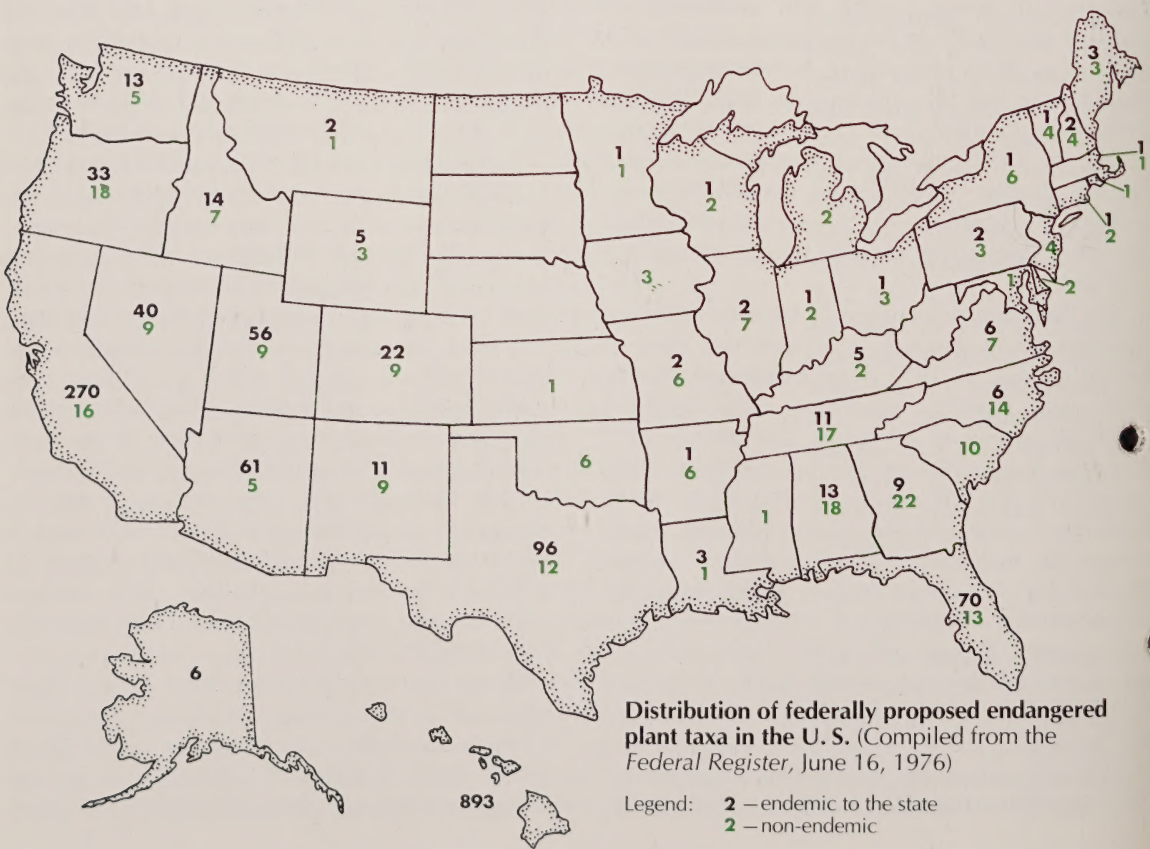
There are two additional steps beyond those stipulated by the amended Act: first, in response to an executive order from President Carter (March 1978) and subsequent Department of Interior rulings, the Service must prepare one or more

other documents that explain the significance and major consequences of each regulation (species listing or critical habitat determination) under the Act on every agency, group, and individual which would be affected by it. Second, the National Environmental Policy Act of 1969 requires an assessment of the impact on the environment of each regulation. The best scientific and commercial data available must be assembled. For most plants this will mean doing new field work to determine current distribution of species and actual or potential threats. Most of our flora is not as well known as the birds, mammals, or reptiles and amphibians, so use of the Endangered Species Act for plants will lag until our knowledge improves—despite the accelerating threats.

The federal government has made some progress in responding to the plant conservation problem. In July 1975 the U.S. Fish and Wildlife Service published in the *Federal Register* a list of the over 3,000 plants contained in the Smithsonian's report, indicating that the species (some found in every state) were being reviewed for protection under the Endangered Species Act. The next step was taken in June 1976, when over 1,700 of those plants (more than half found only in Hawaii) were proposed as endangered species in need of protection (see map). Meanwhile, Fish and Wildlife continues to review the remaining candidate plants.

The amended Endangered Species Act requires federal agencies to make a biological assessment for proposed as well as listed species if construction—or a contract for construction—has not yet taken place on land slated for development. Furthermore, there is considerable federal land in western states (nearly 87 percent of Nevada is federally held). Some of these large areas harbor jeopardized plant species. The agencies administering these lands should take all steps open to them to protect their vulnerable plants, without waiting for the lengthy procedure of establishing official listing and protection under the Act. Some agencies, such as the U.S. Forest Service and the Bureau of Land Management, have developed policies to treat candidate plants as if they were already officially listed. Also, some agencies have hired botanists and plant ecologists, let contracts to evaluate the status of plants or particular areas, and in certain cases changed land-use practices to accommodate the plants.

Over five years have passed since the Endangered Species Act became law. But to date only 22 plants (of the more than 3,000 candidate plants) have been officially listed as endangered or threatened, and only two critical habitats have been de-



Distribution of federally proposed endangered plant taxa in the U. S. (Compiled from the *Federal Register*, June 16, 1976)

Legend: **2** —endemic to the state
2 —non-endemic

termined for plants. Once a species is listed as protected, all federal agencies must be certain that none of their activities jeopardize the species' survival or adversely modify its critical habitat (unless an exemption has been granted). Agencies must consult with the U.S. Fish and Wildlife Service to receive a biological opinion on the effects of any of their actions on the species. Furthermore, agencies must implement appropriate conservation programs for endangered or threatened plants. Land acquisition by the Department of Interior or the U.S. Forest Service is also possible.

There are prohibitions against interstate and international trade for the relatively few candidate species, such as cacti and succulents, which are threatened by collecting. A permit system for legitimate trade was established in June, 1977. However, the Endangered Species Act does not prohibit the collecting of plants as it does the taking of animals. Some other federal and state laws compensate in part for this omission—for instance, by stating that plants cannot be removed from parks. The Animal and Plant Health Inspection Service enforces the international plant trade prohibitions.

Thirteen of the 22 protected plants and both of the critical habitats are in California, the mainland state with the largest number of plants proposed for protection. In addition, the very active California Native Plant Society maintains a priority system on how endangered each vulnerable plant is and maps of the plants' approximate ranges. The Society also has prepared status reports on many of the candidate plants through federal contract. Furthermore, California has passed laws to protect its native flora and has hired a botanist to research the problems of saving vanishing species.

California's system of an integrated network of private, state, and federal efforts should be adopted by other states with major plant conservation problems, such as those with many endemic candidates. Native plant societies have formed recently in several states, such as Nevada, Arizona, New Mexico, Colorado, Utah, and Tennessee. There are some older societies as well. These organizations frequently choose to make imperiled plants their special responsibility. In light of this fact, perhaps it would be helpful to form a national coalition of native plant societies. In other cases, assessments of vulnerable plants are being made through state agencies, as in Missouri, Wisconsin, Iowa, West Virginia, and Georgia. And several other states already have had in effect or have recently passed plant conservation laws, such as Arizona, Hawaii, and Michigan.

The amended Endangered Species Act should provide incentive for developing more protection programs, since it now authorizes plant cooperative agreements between the U.S. Fish and Wildlife Service and the states. These agreements are designed to share the responsibilities of preserving endangered and threatened species when the state meets certain minimal criteria in its protection program, at which time the state usually receives two-thirds federal funding for its efforts. Shared management and administration of an area supporting endangered or threatened species is also possible by federal/state agreement.

It is anticipated that the federal listing process will remain slow. In fact, the amended Act requires that the June 1976 list of over 1,700 proposed plants be withdrawn on November 10, 1979. However, the currently listed plants can each be reproposed for protection as sufficient new information becomes available. Unfortunately, only animals can receive emergency listing under the law. And, as indicated earlier, plants on federal lands would be more easily preserved since the Act has its greatest effect on the activities of federal agencies. Consequently, a species existing on state or private land may receive little or no protection under the Act.

Obviously, an array of plant conservation measures is needed, and Conservancy members can do their share. As a special project, why not adopt a plant that is in danger of extinction? Choose one nearby, find out its full distribution, what threatens it, and what can be done to reverse the threats. For help in starting your project, you can obtain information from local university botanists or from Conservancy regional offices, which can locate appropriate government officials. Or, you can encourage horticultural societies to spend time trying to preserve in nature their "pet" plants, such as cacti and succulents, orchids, carnivorous plants, lilies, palms, rhododendrons, irises, etc. The plants of the sunflower and pea families, which contain the most species on the proposed plant list, are in need of special help—they have no society followings.

Like animals, plants have a right to exist and evolve. The protection measures contained in the Endangered Species Act are not sufficient to insure all species' survival, nor is plant conservation strictly the responsibility of government agencies, or of conservation groups like The Nature Conservancy—it is the public's duty as well. We have other means—some of which have been mentioned—of preserving our country's flora. Use them. Get involved. Plant conservation is a social challenge . . . it is up to all of us to meet it.

A Rose by Any Other Name

by Anne M. Byers
Senior Editor/Staff Writer

A rose is a rose is a rose is a rose. . . . But not really. Did you know that there are 150 different species of wild roses in the world, and 50 in this country alone? I didn't either. But when I walked into the Smithsonian's Botany Department in the Museum of Natural History and saw all the rows of metal cabinets, I began to understand some things that I had been only vaguely aware of before. Those tall cabinets are literally crammed with countless samples of plant species gathered from all over the world. Though they are only a small percentage (and mostly tropical species) of the Earth's myriad plants, the numbers of dried, shelved, and taxonomically classified specimens attest to some bewildering figures.

Including the rose family, there are between 200,000 and 300,000 flowering plants in the world. The Threatened Plants Committee of the International Union for the Conservation of Nature and Natural Resources (IUCN) estimates that about a tenth of these plants are "dangerously rare or under threat." At the same time, in the United States the Smithsonian Institution lists (as of 1978) 839 endangered plant species, 1,211 that are threatened, and 90 either recently extinct or believed to be extinct—10.7 percent of the 22,000 plants native to the continental U.S.

While concern for rare animals is spreading, the value and uniqueness of plants are far less appreciated. I was startled to learn that according to Peter F. Raven, Director of the Missouri Botanical Garden, "a disappearing plant can take with it 10 to 30 species, such as insects, higher animals, and even other plants."

Most disappearing plant species are in trouble because their habitats are being destroyed by development, urban sprawl, logging, overgrazing, strip-mining, irrigation, dams, and land-draining. Off-road vehicles, like dune buggies and motorcycles, are doing their share, eroding soil and eventually killing vegetation. Insecticides and herbicides are taking their toll too. Private and commercial plant collectors add to the problems (see box). Other flora, such as native island species or those restricted to rare habitats like vernal pools, are threatened because their "homes" are already small and consequently vulnerable to human intrusion.

The Nature Conservancy has established over 100 preserves harboring plants considered endangered, threatened, or rare across the country or in their home states. In recent years, some of these lands have been specifically set aside because a

Pitcher plant

Conservancy State Heritage Program identified the areas' imperiled plants—examples: Tennessee's Taylor Hollow; Bluff Mountain and Green Swamp in North Carolina; and South Carolina's Steven's Creek, which supports the endangered *Ribes echinellum*, a gooseberry relative.

Towering high above the Rogue River, Lower Table Rock—pinpointed by the Oregon Natural Heritage Program—is a huge, flat-topped horseshoe-shaped outcropping of basalt. Soils on top of the unique rock support a thick carpet of native vegetation . . . rich, bright-green grasses heavily sprinkled with wildflowers of every color. The Heritage Program staff has identified over 86 plant species on the rock. Many of the plants are native to the region; one of these, dwarf meadow foam, is known to exist only around the edges of Table Rock's vernal pools. It is endangered. Two other plants on the rock are rare—Henderson's fawn

lily and the scarlet fritillary, also a lily. The Conservancy must raise $500,000 by December 31, 1979, to preserve Lower Table Rock, nearby Kelly Slough—which supports over 40 active nests of great blue herons—and the lush valley between them.

Describing all the plants, one by one, for which the Conservancy has preserved habitat would fill up many issues of the *News*. So, the rest of this article will describe a few of the most fascinating. Since, in some cases, the plants are highly sought after by plant collectors, their exact locations will not be given.

Trapdoors and Pitfalls

America has five meat-eating plants: Venus flytraps, sundews, pitcher plants, bladderworts, and butterworts. While all eat insects and an occasional unwary tiny bird or frog, each has evolved a different technique for trapping its prey. The Venus flytrap, abundant in a North Carolina Conservancy preserve, has sets of hinged leaves. Its clamshell-shaped leaves snap shut when an insect or small animal touches the trigger hairs inside the leaf halves; then the meal is slowly digested.

The aquatic purple bladderwort floats in acidic ponds and streams. Hanging beneath the plant are

Top: white fringed prairie orchid. Above: Dudleya nesiotica, *a diminutive live-forever endemic to Santa Cruz Island.*

Clark Creek, Mississippi, a 1978 donation to the Conservancy from International Paper Company, hosts the rare Alleghany spurge (Pachysandra procumbens).

tiny tubular bladders, each of which has an opening at the lower end covered by a flap or trapdoor. Trigger hairs are on the outside of each "door." If an unsuspecting water spider happens to "tickle" the hairs, the trapdoor flies open, the spider is sucked into the bladder in a rush of water, and the door slams shut behind it.

Pitcher plants, unlike the flytrap and bladderwort, are "passive" plants. Shaped like a long tube, a pitcher plant lures its prey to the top of its tube with a fragrant substance. The victim enters or slips into the "pitcher" and is unable to climb out because thousands of down-growing hairs line the inside of the tube. Exhausted, the animal drops to the tube bottom where it is digested.

Also "passive" plants, sundews and butterworts use a flypaper method to entrap their prey. With its brilliant ruby-red coloring and sweet nectar covering its leaves, the sundew looks appetizing to a hungry insect. Upon landing, however, the insect victim becomes helplessly mired down in the thick, sticky nectar. The sundew leaf then rolls around its prey like cigarette paper around tobacco, and digests it.

Because of their unusual diets and fascinating appearance, carnivorous plants are among the most sought-after species by both private collectors and commercial plant dealers. Dr. Donald Schnell, author of *Carnivorous Plants of the United States and Canada*, has seen the wide-scale harvesting of these plants, especially the Venus flytrap, which is supposedly protected by law in North Carolina. I asked him what could be done to adequately protect the species. "I agree with C. Ritchie Bell, Director of the North Carolina Botanical Garden," he said. "Protection can be accomplished only by strictly forbidding the sale of carnivorous plants, both in the state and nationally. Legislation aimed at collectors is not going to do the job—it must be aimed at those who sell."

An additional problem in saving our meat-eating species is that the few areas in which they grow—usually lowland areas of mineral-poor bogs and swamps—traditionally have been drained, dredged, and filled in. Along with preserves on the southeast coastal plain, the Conservancy has established a large sanctuary in Texas that serves as habitat for four of the country's five carnivorous plants.

In the Air and on the Ground

The orchid family (*Orchidaceae*) is very large, comprising 10,000 to 15,000 species distributed all over the world. They may be terrestrial, epiphytic (obtaining food from the air), or saprophytic (obtaining food from dead, organic matter).

The white fringed prairie orchid is primarily a species of the grasslands. It occurs on three Conservancy prairie preserves, two in Minnesota and one in Wisconsin. However, it also is found in only *one* place in New England, on a Conservancy sanctuary in Maine. Besides being the state's rarest orchid, the plant is a relict or remnant species—the easternmost colony of white fringed prairie orchid in North America. Since it is partial to wet meadows, the orchid feels at home in its hidden Maine bog. It is classified as a threatened species by the Smithsonian.

Another nationally threatened orchid, the small white lady slipper also prefers wet prairies, though it's usually found in a fen, or alkaline bog, as opposed to the acidic sphagnum bog preferred by the fringed prairie orchid in Maine. But like its cousin, the lady slipper is disappearing because of habitat drainage, plowing, grazing, and over-collecting. This little orchid is the daintiest of all the lady slippers. It has been well protected in Minnesota, where the Conservancy has set aside several of its prairie homes, including an area contained in the Minnesota Prairie Chicken Preserve System. The lady slipper also occurs in a recently acquired prairie in Michigan, sharing its habitat with 14 other state rare or threatened plants.

(For a description of another exceedingly rare and seldom seen terrestrial orchid, the small whorled pogonia, see the Fall 1977 issue of the

News. The whorled pogonia exists on a Conservancy preserve in New York State.)

Epiphytic orchids are migrants from the hot humid tropics. In this country, they are found only in southern Florida, except for the greenfly orchid, which extends as far north as the Carolinas and is found on tree limbs overhanging the twisting, meandering waterways of Four Hole Swamp (a cooperative project with the National Audubon Society in South Carolina). Though growing on other plants, epiphytes are not parasitic. They use their "host" purely for support, not nourishment. In companionship with epiphytic ferns (such as the resurrection fern) and bromeliads (like Spanish moss), the orchids create aerial gardens in the treetops, securing their roots in the bark of branches and trunks. They are also called air plants, literally taking their food from the air, from rainfall, and from accumulated leaves, dust —whatever the wind carries to them.

Many of these aerial orchids are breathtaking—the night-blooming orchid with its white spider-like flowers, which are more fragrant at dark; the widely distributed clamshell orchid and unusually colored butterfly orchid; the spider orchid, a strikingly beautiful species that may be on its way to extinction in southern Florida. The cowhorn or cigar orchid is one of the largest epiphytic orchids found in the state, as well as one of the most unusual looking. It used to be quite common. Because of collectors, however, it is now rare, even though it's easily propagated from seed.

The Conservancy has created many sanctuaries in Florida—Blowing Rocks, Fuchs Hammock, Janet Butterfield Brooks Preserve, Tiger Creek, Crescent Lake, the Honorable Theodore Roosevelt Preserve, Hobe Sound, Fakahatchee Island, Rookery Bay, Ten Thousand Islands, Lignumvitae and Shell Keys, St. Vincent Island (to name a few). Several of these preserves support a variety of native epiphytic and terrestrial orchids, as well as other rare plants, such as bromeliads, Florida royal palm, wild indigo, St. John's wort, cabbage palm, Florida yew, saw palmetto, and many more.

Maulua Nui

Island plant species are particularly vulnerable to human disruption. Our fiftieth state is a prime

Epiphytic orchids thrive on Lignumvitae Key, a 1971 project of the Conservancy and the State of Florida.

Stately koa trees, whose trunks reach diameters of four to six feet, grow on the slopes of Mauna Kea, Hawaii.

and sad example: according to the Smithsonian, over 50 percent of Hawaii's native flora is either recently extinct, endangered, or seriously threatened. Of this percentage, 12.3 percent, or 270 plant taxa (species, subspecies, and varieties) have been extirpated. (For an explanation of how this phenomenon occurred, see the Fall 1977 issue of the *News*.) Nowhere else in the U.S. is habitat protection more needed than in Hawaii.

Lying on the slopes of the state's highest peak, snow-capped Mauna Kea, an area known as Maulua Nui stretches from a height of 6,000 feet all the way down to sea level, where it ends in a spectacular gulch with cascading waterfalls. Late last fall, the Conservancy completed two years of negotiations that culminated in the purchase of a 3,300-acre tract and a conservation easement on 101 acres in the center of Maulua Nui, and acquisition of an 18 percent undivided interest in an adjacent 2,971 acres. The Conservancy's preserved land supports one of the finest stands of native rain forests remaining on the island of Hawaii—a lush koa-ohia forest.

Ohia lehua and koa trees are typically Hawaiian and comprise an ecosystem that is now considered endangered. Commercially valuable, stately koa trees may have either a many-branched trunk or a single trunk of great width. Hawaiians used to fashion their canoes from the wide-girthed koas.

There are many subspecies of ohia lehua trees, some only tiny shrubs, others towering giants, between 50 and 100 feet tall. But the ohia's most remarkable characteristic is its ability to grow on the ground or as an air plant. Easily air-borne, the ohia's seeds may hitch a ride on a sadleria fern. They may then take root in the fern's branches, extend roots to the ground, and eventually strangle the supporting plant. Because the ohia lehua can propagate itself in this way, early Hawaiians believed that the sadleria fern was the parent of the ohia tree.

On the moist slopes of Mauna Kea, the majestic koas reach trunk diameters of four to six feet, while the ohias tower up to 100. The trees create a remarkable setting: the koas' far-spreading branches and long slender leaves are complemented by the straight trunks of the ohias, their small round leaves, and bright scarlet pompon-like blooms. But the pristine koa-ohia forest of Maulua Nui offers more than beauty—it provides vital habitat for several endemic (native) and endangered birds, including those of the *Drepani-*

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didae family, or Hawaiian honeycreepers. These rare birds, such as the amakihi, apapane, akepa, Hawaiian creeper, and akiapolaau, feed on the ohia's brilliant flowers and on certain special insects that are peculiar only to the ohia and koa trees.

The Next Step?

Habitat protection for all plant species, not just Hawaii's, cannot be overemphasized. But habitat preservation alone is not enough to save those plants that are under additional pressure from collectors, both private and commercial.

Enforcing present laws and enacting new ones will help, but they must be uniform across the country. For instance, Arizona's tough plant law, which is strictly enforced and designed to protect the state's purloined cacti, threatens the plants of neighboring states where no such laws exist. So what *can* be done?

Bruce MacBryde of the Fish and Wildlife Service's Endangered Species Office said "the first thing to do is offer plant collectors an alternate source through cultivation—propagate those species that can be grown and sell them." Cultivated plants could be used to educate the public about the rarity of their wild relatives. For instance, a tag on a cultivated orchid could say, "This plant was grown from a seed because it is disappearing in the wild and must be protected." Edward Ayensu, Director of the Office of Biological Conservation at the Smithsonian Institution, further proposes that "commercial dealers and nurseries selling pressured plants be made to produce certificates [stating] that they (the plants offered for sale) were grown from seed."

But what of the species that cannot be cultivated? Bruce MacBryde suggests a combination of enforcement and widespread conservation education. "Laws will not be enforced or obeyed unless they have public support," he warned. MacBryde recommends outlawing the sale of sensitive wild plants all together and, at the same time, conducting a massive program to teach the public which plants are rare and what the consequences are if they are lost.

It should be understood that cultivating a plant may help solve the problem of enforcement but it won't answer the problem of endangerment. Habitat protection and greatly increased public understanding are the keys. A plant in a greenhouse but not in the wild will not help us maintain Nature's balance or biotic diversity. Nor will it save the species called *Homo sapiens* when species loss has brought about irreversible alterations to its only known habitat, Earth.

PLEASE DON'T PICK

Whether the culprit is a next-door neighbor out to make a little extra money or a large commercial firm that peddles around the world, plant collectors also are extinguishing our vegetation. Of the 2,140 plant species contained in the Smithsonian's 1978 publication, *Endangered and Threatened Plants of the United States,* 77 are listed separately because they are "commercially exploited."

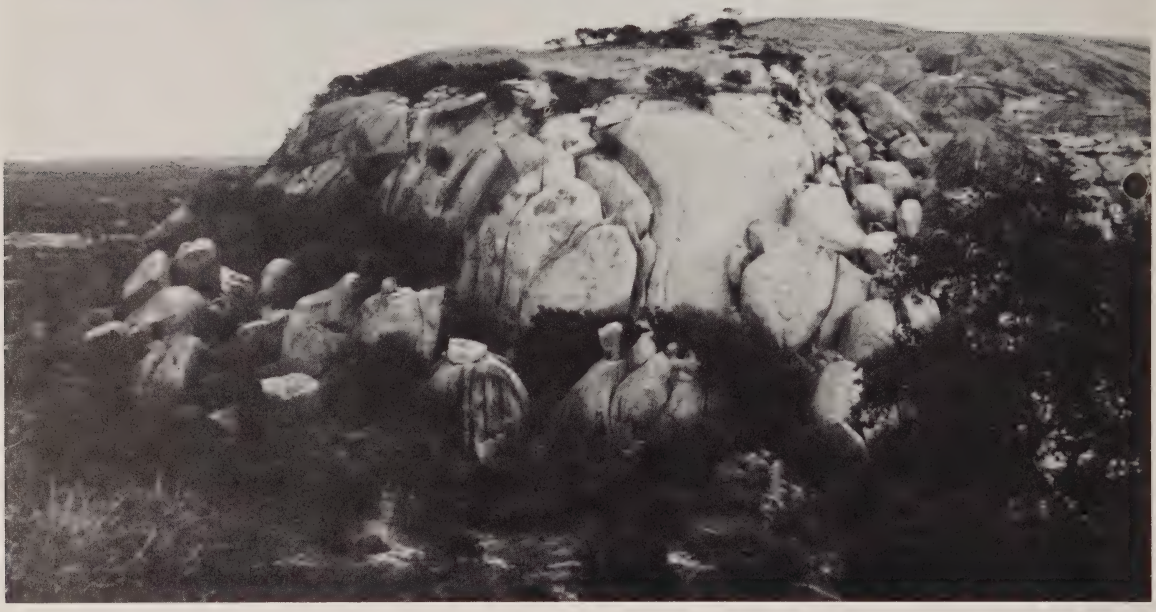
According to a 1976 *National Wildlife* article, "Collectors, private and commercial . . . often . . . put pressure on the very species that are in the greatest danger." This is not surprising. Plant catalogs often emphasize the rarity of a species as a highly desirable character, usually quoting the highest prices for uncommon and difficult-to-find natural plants. The rarer something is, the more people want it. Plants are no exception, and owning uncommon plants has become a fashionable hobby everywhere. In the last 12 years, collector clubs in the Soviet Union have grown from 3 to 114. Cacti are very popular, especially with the Japanese—Arizona's giant saguaro cacti are going for $40 a foot in Tokyo. In 1976 a commercial dealer dug up more than one-half million rattlesnake orchids in Tennessee to put in mail-order terrariums. Another dealer wiped out an entire colony of green pitcher plants in Alabama, reducing the viable stands of the species by 25 percent.

Many species of wildflowers cannot be successfully transplanted, either. They need specific combinations of soil, climate, moisture, overhanging or neighboring plants, particular insects, and other exact factors. If a plant's roots are damaged or broken during removal, the plant will die from fungus attack. This is particularly true of some uncommon orchid species. In the *National Wildlife* article, Carlyle A. Luer, an orchid expert, pointed out that "99 percent of American terrestrial orchids sold by commercial firms die within two years."

The point of these statistics and facts is that plants—unlike ducks—have no bag limits. Few states have laws prohibiting the picking or digging up of their rare plants; and where laws do exist, they are usually erratic and very difficult to enforce. At best, most enforcement amounts to little more than a slapped hand. Strong enforced laws prohibiting the sale of rare plants are a vital adjunct to any preservation program.

Enchanted Rock:

Land of Legend and Life



by Elizabeth C. Mooney

You can see Enchanted Rock from a long way off, a giant inverted granite mixing bowl rising out of the rolling cedar and oak savanna of Llano County, Texas. Nothing from a distance prepares you for the scale of Enchanted Rock—it covers more than a square mile and dwarfs everything around it. Not until you stand at its base and measure your own height against this tremendous outcropping, do you appreciate the full impact of the largest granite dome between the Rockies and the Appalachians.

The rock is ancient, over a billion years old. It rises from earth rich in archeological history dating back to more than 12,000 years before the white man ever saw this country. A sandy creek winds at its base, intermittently dry in the arid Texas summers. The rock rises grandly 325 feet above the creek, a pink granite mass so smooth that, in leather shoes, you could lose your footing on its trails. Huge slabs of its bulk have peeled off and lie at the base. The rock is very, very slowly shedding its "skin."

Prehistoric Indians venerated Enchanted Rock, believing it to be haunted by the ghosts of a chief and members of lost tribes, as well as by the spirit of a wild white woman. After a rain, the rock drying in the sun and wind emits an eerie, mournful sound, which some say is the souls of these dead crying out. The dome is the scene of various natural phenomena, which add to the legends—spirit fires on the summit, the daytime reflection of millions of mica stars, streams of water that look like molten silver pouring down the rock's sides.

At the base of the dome are the archaic remains of an Indian culture some 8,000 years old—fire pits, dart points used to hunt mastadon, pot shards and the remains of burned hearthstones, stone tools and animal bones. Because of its contribution to our knowledge of the prehistoric Indians, the rock has been proposed for the National Register.

Enchanted Rock is constantly changing. Lichens attach themselves to its surface, turning the pink granite to blue, yellow, seagreen, and grey in small patches. At sunset, the shadows in the rainwater-filled niches turn from grey to gold. Gusty winds play on the summit, and small lakes at the dome's front and back sparkle in the sunlight. Looking down from Enchanted Rock across Watch Mountain, Dutch Mountain, and the rest of the Edwards Plateau, it is difficult not to feel that you are truly on top of the world.

Foothold for plants, ferns, and grasses is precarious on Enchanted Rock, for the soil islands carved by the rain are sparse and fragile—always

in danger of desiccation in the sun and wind. For decades, the vegetation struggling for existence in these islands has also been threatened by campers and picnickers who have been attracted to the park containing the huge dome. Students and collectors carried away specimens of rocks and ferns. Motorcyclists chipped away at the ancient geological formations by riding up and down the trail on the face of the rock.

Things will be different now. The Nature Conservancy has purchased the property, located 17 miles north of Fredericksburg, and has transferred Enchanted Rock to the Texas Parks and Wildlife Department for a recreational, scenic, and natural resource. A Dallas land developer's dream of condominiums with a view of the dome is punctured forever. Enchanted Rock and the vegetation clinging to it will be preserved for the enjoyment of those who care about protecting the fragile habitat of small wild plants.

Because of this transaction, 15 species of rare and endemic plants growing on or near Enchanted Rock will have a better chance of survival. Under the management of the Texas Parks and Wildlife Department, no plants or rocks can be removed from the area. Wardens will be on duty to see that the law is observed.

Rarest of all the species now safely under the wing of Parks and Wildlife is the lovely, delicate annual bellflower (*Campanula reverchonii*). *Campanula* takes its common name of bellflower from its tiny light blue blossoms clinging to erect stems. The bellflower is very rare in Texas, and the Smithsonian Institution's 1974 survey regards it as threatened—meaning likely to become endangered. (The official federal list of threatened plants relies primarily on Smithsonian recommendations.)

There are few places in the United States where *Blechnum occidentale* feels at home enough to flourish, and the Enchanted Rock area is one of them. The genus of this little fern grows in British Columbia and is far from rare in Mexico and the West Indies. But it took a fortunate southeasterly wind from one of those places to bring a few spores of this rare variety to Llano County. *Blechnum* looks a good deal like the locally common fairy sword, and it is possible that some past fern collectors have mistaken the rare plant for the prolific native and transplanted it to their private gardens. Even the most optimistic botanists do not expect the fern to spread from its Texas outpost, so an undisturbed habitat for this immigrant is essential.

Rooted in the mud of the pools at the summit of Enchanted Rock and at its base is pillwort (*Pilularia americana*), a small and inconspicuous, densely massed creeping plant that rarely grows as high as four inches. Pillwort is endangered in Texas because it prefers semi-permanent pools in granite soil, and in a largely arid state, such bodies of water are not plentiful. In rapidly drying soil, pillwort fails to develop fruiting cases and does not reproduce. Nor does spore germination occur in chalky earth. The plant is rare in similar habitats in western and central United States.

Often found in company with pillwort in wet areas is quillwort (*Isoetes lithophylla*), considered endangered by the Smithsonian in its last survey. This rare little plant looks like a tuft of pin-like leaves, only microscopically different from other less threatened species, the difference being in its reproductive spores. Fond of shallow depressions in granite, the quillwort is endemic (grows nowhere else), because its need for a highly specific and fragile setting restricts it and limits its ability to spread.

Its more tolerant cousin, *Isoetes melanopoda*, a quillwort less insistent on special conditions, is widespread in the eastern United States, but endangered in the pineywoods of east Texas. Here in central Texas near Enchanted Rock it is at home.

For decades the land around Enchanted Rock has been grazed by both sheep and cows. Sheep, never a favorite animal in Texas because they crop grass so closely, have largely destroyed a rare species of ragwort (*Senecio ampullaceus*). With its bright yellow flowers, ragwort is related to the asters and sunflowers and should not be confused with ragweed. The last survey of the area around the rock uncovered no specimens of this flower, endemic in Texas. But since the grazing of sheep has been forbidden, ragwort is coming back. Future plans for the area include a limited number of grazing cows, but these are not expected to affect this flowering herb. Grazing has been a problem at Enchanted Rock. A flock of goats completely devoured the seeds from the sycamore leaf snowball, styrax.

Scores of Sunday painters have dragged an easel and a box of paints into a field to try to catch on canvas the beauty of a field of bluebonnets (*Lupinus texensis*), which Texas chose as its state flower. Early in the spring, the fields of central Texas are covered with this little blue flower, great splotches of which spread their blue blankets across the plains near Enchanted Rock. But *Lupinus texensis*, a member of the pea family, is indigenous only to a small part of the Lone Star State, and preserving the habitats in which it feels at home is especially important. The bluebonnet could not be a more suitable choice for the Texas state flower, for it grows well on dry, poor, sandy soil and—because of its bitter taste—cattle will not eat it.

Another native Texan, *Phlox pilosa,* subspecies *riparia,* adorns the floodplain of the sandy creek at the foot of the dome, but is restricted to just such places on and near the Edwards Plateau. Its large, varicolored blossoms grow on plants up to eighteen inches, dotting the sandy soil where many plants do not thrive. Seeds of this genus were imported to England for cultivation in the spring of 1835.

In a pool near the top of Enchanted Rock is the primitive fern, *Ophioglossum crotalophoroides,* which looks much like a miniature wild orchid. Also known as adders tongue, the fern is rare and endangered. It grows mainly in the sandy soil of east Texas and in Mexico and South America; so the specimens at Enchanted Rock probably are the western outpost of the plant's range. With the recent heavy rains in the area and the ban on grazing, adders tongue is staging a comeback, much to the delight of botanists. If you happen upon this little plant in one of the rock's pools, you can recognize it by a small spike which resembles a snake's tongue, sitting atop a stalk that grows out of leaves unfurling from a tight curl.

Juncus validus, variety *fascinatus,* is a rare variety of a common species—a rush more than a yard tall with a stalk half an inch thick. It enjoys keeping its feet wet and has established clumps in some of the niches carved by centuries of rainfall on Enchanted Rock. In summer it bears a cluster of brown flowers with as many as fifteen heads. It is found only in the central mineral region of Texas and surrounding areas.

In the granite crevices and slopes near the dome grows a rare and endangered low-tufted perennial grass called *Tripogon spicatus,* a tight little cluster of spikelets and florets unnoticed by most passers-by. But the grass lives only in the rocky hills of central Texas in this country, and plant specialists are pleased to find it abundant near Enchanted Rock.

Texas bluebonnets (Lupinus texensis) *are native only to a small part of the state.*

Endemic to central Texas and seasonally common on the plains surrounding Enchanted Rock is an odd little bush bearing simultaneously both airy blossoms and green bladders filled with pea-sized seeds. Its Latin name is *Lesquerella densiflora,* but it is better known as bladderpod or sometimes burro fat. Hikers coming upon it for the first time find it difficult to believe the same bush can produce both crops in the spring. Bladderpod is not only a curiosity but has an unusual, disagreeable odor.

A plant which the natives call spiderwort (*Tradescantia gigantea*) is also endemic in central Texas, where it seeks out moist crevices and puts forth its deep violet-blue flowers between March and May. *Tradescantia* was named for John Tradescant, gardener for Charles I of England. Tradescant was so interested in plants and fruits that he is said to have sailed as a privateer against Morocco with the sole aim of stealing apricots to bring back and introduce into English soil. In the fields near Enchanted Rock, spiderwort seeks partial shade near water. Look for this plant in the morning, for its bloom droops and fades in the hot sun by afternoon.

Fern specialists are happy that the endangered fragrant fern, *Cheilanthes kaulfussii,* will be protected by The Nature Conservancy's preservation of Enchanted Rock. A rare lipfern with relatives in the Trans-Pecos region, the little plant has aromatic fronds covered with unusual glandular hairs.

Texas Parks and Wildlife spokesmen say they hope that with better protection the dome's rare plant species may spread from the soil islands where they are now confined. No fires or camping will be allowed on the soil islands of the rock, and self-guided trails will steer clear of habitat supporting the rare plants. A reception center will be built at the entrance to introduce visitors to the unusual preserve they are entering. Plants and geological formations will be carefully guarded by wardens. Picnic tables will be confined to the west side of the rock and camping sites to the east, both spots where compacted soil is suited to human traffic.

Under the new guardianship, nothing will be allowed to interfere with what botanists think is a rare opportunity to encourage the survival of plants whose future earlier was a question mark.

Elizabeth C. Mooney is a free-lance writer whose articles have appeared in *American Heritage, Defenders, Newsday, McCall's,* and many other publications. She is also the author of three children's books; and her most recent book, *In the Shadow of the White Plague,* has just been published by Crowell.

Flowering avens

Fir clubmoss

Bluff Mountain

Wood lily and phlox

Of Polygons and Plants

by Michael A. Godfrey

Bluff Mountain, Ashe County, North Carolina. This 5,000-foot ridge in the state's northwestern corner assembles botanical extremes and unusual landforms in a profusion unmatched on the North American continent. As continuing explorations yield new biotic treasures, the North Carolina Nature Conservancy is raising funds to pay for the acquisition of the 720 acres surrounding the mountain's summit (the land was purchased last December), to provide proper stewardship of the area, and to establish Bluff Mountain as a Conservancy model preserve for educational and research uses.

The mountain's remarkable array of natural features leads Dr. Albert E. Radford, a practitioner of plant ecosystematics (the ecology and classification of plant communities and plant distribution), to state flatly that "no area of comparable size east of the Mississippi equals Bluff Mountain for natural diversity." Radford is in a position to know. A tireless field botanist, he is said by some to be one of the most knowledgeable researchers on the overall flora of the southeastern United States. Professor of Botany at the University of North Carolina, Director of the UNC Herbarium, prolific author, Chairman of the North Carolina Natural Areas Advisory Committee, and holder of the Conservancy's Oak Leaf Award, Radford has devoted part of his distinguished career to developing a system of classifying ecological diversity. "I've been studying Bluff Mountain for over 20 years," says Radford, "and I felt I was familiar with it from my field work; but when you get it all down on paper, the biological significance of the place boggles the mind."

Meanwhile, other biologists have fleshed out Radford's profiles on Bluff Mountain. Professor Lewis Anderson of Duke University's Botany Department has studied the "unique array of mosses that grow at the limit of their southern ranges" in the mountain's bog. Anderson is most interested in *Sphagnum subsecundum,* a moss "not known between Pennsylvania and Bluff Mountain, which has a disjunct (separate) population existing at its southern limit on the mountain." His other en-

Gray's lily, threatened in North Carolina and endemic to the state, is found at Bluff Mountain.

thusiasms include *Buxbuamia minakatae,* a moss known to exist in only three places—Nova Scotia, Japan, and Bluff Mountain; and *Grimnia cribrosa,* "a very rare species," according to Anderson, "disjunctive from its habitat in New York State to Bluff and nearby Jefferson Mountains." Anderson fears, however, that the Jefferson Mountains' population has been wiped out by tourists.

Another Duke Botany Professor, Dr. William Louis Culberson, reports that a very rare lichen, *Cladonia psoromica,* which grows nowhere else in the world other than Bluff Mountain, produces psoromic acid. It is the only one of hundreds of species in the genus *Cladonia* to do so. Psoromic acid is in a class of compounds of potential value in medical research—research that is now in progress in the USSR and in Finland. "A close examination of lichen products for medical purposes in this country is just inevitable," writes Culberson.

Bluff Mountain's unusual geomorphic features (land-forms) are as significant as the area's plant communities. Another Duke University Professor, Dr. W. D. Billings, believes that the mountain's stone polygons are unique. Stone polygons, or nets, are rocks that are arranged by the freezing action of the soil. Billings compares the shape of the nets to the honeycomb pattern of plant cells as seen under a microscope—five- or six-sided polygons a foot or less in diameter. "These miniature stone nets are characteristic of alpine regions much farther north," says Billings. "They are formed by the frost action pushing upward from the solid rock below the mountain's bog, causing the stones to be 'shed' away from uplifted central points. Needles of ice keep plants from gaining a foothold, so the stones can move freely on the bare frozen ground. There are only a few other examples of stone polygons in the lower 48 states and most of these are fossils (no longer active or maintained by frost action) and much larger. The only other stone polygons which approximate those of Bluff Mountain are found on Mt. Kenya in Africa. They are similar in appearance, except that on Mt. Kenya the freeze-thaw cycle is diurnal (twice a day) rather than annual."

Bluff Mountain looms from the spine of the Appalachians near Jefferson, North Carolina. It rises from a base at 3,500 feet to three well-defined peaks, the central and tallest called "Cowface," which reaches 5,073 feet. At intervals along the five-mile crest of the ridge are outcroppings of a mineral named hornblende. One of the largest of these outcroppings forms the fabled Perkins Rock, another a spot called the "Looking Off Place." Both of these exposures afford spectacular views of the nearby mountains.

The ridge also supports a unique gale-twisted forest of Carolina hemlock, the largest of the state's few remaining stands. It is interspersed with open rocky areas of low heaths that contain rare associations of great rosebay and purple rosebay (both rhododendrons), along with the endangered endemic plants, flowering avens and wretched sedge. Under the crest's eastern lee, the gentle slopes shelter cathedral groves of immense virgin sugar maples in an unusual association with heath shrubs. Virgin stands of northern red oak, white oak, red maple, and sugar maple form a mosaic on other parts of the ridge's eastern slope.

One thousand feet below "Cowface," Bluff Mountain's slope levels to what geologists interpret as a remnant of the Schooley Peneplain—the result of the first erosion cycle that occurred after Africa and North America collided 450 million years ago and squeezed up the land that we now call the Appalachians. In this flat area, the nutrient-rich waters seeping down from the summit enter a peatland which has a true (nutrient-poor) bog at its center. On the periphery of the bog, however, the nutrients disperse into the peatland and enrich the flora far beyond that of a true Appalachian bog. Thus the topography coupled with Bluff Mountain's harsh climate result in a glacial

relict bog-fen community where rare and endangered northern and southern plant species intermingle. Here the nearly-vanished bog turtle forages amid endangered plants growing at the end of their ranges, such as muhly (a northern grass), a sedge called white beakrush, and carnivorous plants usually found in the Coastal Plain.

Calloway Glades, as the bog/fen is known, yields its water over the edge of the sheer rock bluffs for which the Mountain is named. The gleaming ribbon cascades hundreds of feet into a primal stand of cove hardwoods at the foot of the bluff. On the spray-misted exposed crags, native Carolina saxifrage and wretched sedge grow together with the threatened moss pink, a phlox, and three-spotted cinquefoil.

What accounts for Bluff Mountain's remarkable assemblage of life schemes, and scenic and geomorphic wonders? It is known that the southward movement of the Pleistocene glaciers pushed the earth's climatic zones southward, so that as the ice enveloped Pennsylvania, North Carolina's vegetation became boreal (northern). Many of the boreal plants remain on the Mountain, which is one of the few locations—and for some plants the only site in the eastern U.S.—with conditions that permit the northern plants to survive. In addition, perhaps the same ice that drove the temperate zones before it spared a few resolute southern plant species, which now post their northern lookouts on Bluff Mountain. The combination of the Mountain's soil developed from the mineral hornblende in association with Bluff's weather, drainage, altitude, and topography somehow combine to create unique living conditions and matchless biotic societies.

A final ingredient—inaccessibility—has traditionally protected the tapestry of time and life woven about Bluff Mountain's rocky shoulders. Moderate timbering and casual herding have so far been the principal enterprises. But now, when virtue is measured in ski slopes and silvan second homes, riches of another kind attract developers. And dirt-bikers have discovered the ecstasies of doing wheelies in the bog/fen. Bluff Mountain desperately needs protection.

Since the early 1950's, the families of M. E. and W. G. Edwards held title to the priceless slopes and summit, assembling, over time, 14 smaller tracts into the present 720-acre biological unit. The Edwards family declined a number of bona fide offers to develop Bluff Mountain as a ski slope or summer resort, offers far in excess of the price at which they made the tract available to The Nature Conservancy. Their fidelity to the conservation ethic, common in rhetoric but scarce where bank accounts are involved, is responsible for Bluff Mountain's present integrity. The amount of $270,000 ($375 per acre) will secure the tract. An additional fund of $125,000 will provide permanent stewardship, as well as educational scholarship monies to implement the scientific studies needed to inquire into Bluff's biological secrets and to share its gentle beauty with the public.

When the funds are raised—and a recent $175,000 pledge from Z. Smith Reynolds Foundation lends encouragement—the Conservancy plans to include Bluff in its system of model preserves. To ensure protection of the fragile environment, while at the same time providing access for scientific study, the North Carolina Botanical Garden has entered a proposal for participation in the stewardship of the site after acquisition. The Botanical Garden is considering a program of interpretive tours and seminars for the public on a strictly controlled basis, consistent with the Mountain's safekeeping. It is a Conservancy precept that the natural lands it holds in trust be made available for the enrichment and education of the public, to the extent that sound stewardship permits human use. Model preserves are of particular value as showcases for the advancement of public awareness of the need to preserve unique elements in our natural heritage. With the Mountain's existing trail system, easily controllable access, and the professional staff re-

Bluff Mountain supports the largest of the state's few remaining stands of Carolina hemlock.

Bluff Mountain is the only site in North Carolina where purple clematis (Clematis verticillaris) *is found.*

An exceptional lichen flora exists on Bluff, making it an excellent research and study area.

sources of the Botanical Garden, such a program could be highly successful at Bluff Mountain.

It is a testament to the social awareness and activism of the scientific community that Bluff Mountain's value has been revealed. Hard-working botanists and field naturalists have taken the lead in identifying this botanical jewel in the Appalachians. It is now up to us of the outdoors-loving public—we who will ultimately benefit—to work for Bluff Mountain's permanent preservation. C. Ritchie Bell, Director of the North Carolina Botanical Garden and co-author with Dr. William Justice of *Wildflowers of North Carolina,* says, "I consider Bluff Mountain to be Nature's own climatron, a natural aggregation of contrasting ecosystems with unparalleled potential for natural science research and for public enrichment. And the cost of preserving it is minimal. Bluff Mountain is the greatest bargain available to America's conservationists."

Michael Godfrey is a natural history writer and photographer living in Chapel Hill, North Carolina. His works include *A Closer Look* (Sierra Club Books, 1975) and *Winter Birds of the Carolinas and Nearby States* (John Blair, Publisher, 1976). He is presently writing *A Naturalist's Guide to the Piedmont,* to be published by Sierra Club Books.

Ecology Forum

No. 31
by Steven C. Buttrick
Plant Ecologist

LOWER BUT NOT LOWLY

The other articles in this rare plant issue of the *News* have dealt almost entirely with what are frequently called "higher" plants, a group that encompasses all the ferns and fern allies, herbs, shrubs, and trees. However, lower plants, which include the algae, fungi, lichens, and mosses, represent a quarter of the world's plant species. The terms "lower" and "higher" reflect the differences in structural and anatomical complexity of the species, *not* their value to man or their importance in nature. Ironically, "lower" and "higher" also reflect their size. Lacking vascular tissue, which the higher plants all have, lower plants cannot efficiently transport water and the products of photosynthesis long distances through their bodies. But of necessity, then, lower plants are generally very small, growing close to the ground, and frequently restricted to wet or humid habitats.

Many plants are named or called moss which are not. For instance, the green "moss" that colors the bark of trees—especially on the north side—is usually an alga, not a moss. Reindeer moss and Iceland moss are actually lichens. Irish moss is an alga, and Spanish moss is a vascular flowering plant related to pineapples. Mosses are practically ubiquitous, growing in such diverse habitats as New York City sidewalks and Antarctica rocks. But they develop best in the dark, damp evergreen forests of our west coast, which have more and larger mosses than any part of the continent. Species of *Sphagnum* or peat moss are the major component of peat, which is used to pack nursery stock. In the USSR and Ireland peat is burned to generate electricity. But the major importance of mosses is the role they play in nature as colonizers of bare land and rock surfaces. Here they trap particles of dust and dirt, contribute their own tissue to the soil, and hold water in their closely overlapping leaves. In this way they provide a seed bed for higher plants and pave the way for further succession. The water-holding capacity of mosses is extremely important in controlling soil erosion.

Algae, leafless lower plants, attain their maximum diversity in aquatic habitats. However, some species are terrestrial, growing on soil, rocks, snow, and other habitats as exotic as the hairs of the three-toed sloth (a situation that frequently causes the sloth to look green).

Single cell marine algae are a major constituent of plankton, which is the base of the food chain that supports the life of our oceans. We use some of the large brown and red marine algae as fertilizers and food. Extracts from algae are used in the manufacture of such everyday items as shaving creams, lotions, pills, candies, toothpaste, and ice cream.

The fungi are a very diverse group of plants that include not only mushrooms and puffballs, but molds, mildews, rusts, smuts, and yeasts as well. Over 46,900 species have been described. Because they lack chlorophyll—and thus cannot produce their own food—fungi must live on organic matter. Along with bacteria, fungi decompose vast quantities of dead organic material that would otherwise rapidly accumulate and make the world uninhabitable.

Fungi have always been an important food source for man, but of the mushrooms only a variety of the common meadow or field mushroom (*Agaricus campestris*) has been successfully cultivated and grown commercially. Morels and truffles are two other commonly eaten species, but both have defied attempts at cultivation. Fungi are important in baking and brewing, and in manufacturing many cheeses. The antibiotic penicillin is obtained from a fungus.

A lichen is a composite plant; that is, it is composed of two organisms, an alga and a fungus. Although dual in nature, a lichen behaves as a single organism with the ability to reproduce itself. Therefore, it can be classified into species, genera, and families like other organisms. Lichens provide pasture for caribou and musk ox in arctic and subarctic regions and total food and shelter for

many small organisms. Northern explorers running out of other food have been forced to eat a lichen called rock tripe. Long string-like lichens are used by birds such as the golden plover and parula warbler to build nests. Lichens have been used to produce sugar, are used as dyes, and are essential ingredients in perfumes. Also, antibiotics are now being isolated from lichens for treating Mycobacterium tuberculosus, varicose and trophic ulcers, and second and third degree burns.

Of the over 360,000 species of plants in the world, lower plants comprise about one-fourth, or 90,000 species. This 3:1 relationship is certainly not reflected in federal and state lists of threatened and endangered species. As I have pointed out, lower plants play a vital role in nature and are of considerable value to man. Certainly in terms of natural diversity all plants are created equal. There is nothing intrinsically more important about the San Clemente larkspur (*Delphinium kinkiense*), a federally listed endangered plant, than about *Cladonia psoramica,* a species of lichen found only on Bluff Mountain in North Carolina. The criteria for preservation should be rarity and endangerment. Why, then, are the lower plants neglected?

A major reason for the under-representation of lower plants is simply a lack of information. Their rarity frequently just reflects the fact that so few people can identify lower plants and fewer still are out looking for them. In general, we lack knowledge of what species are out there, their numbers, and their distribution.

The fungi are a good example of why information about lower plants is so scarce. For instance, by using complicated techniques in a lab, it is possible to find over 100 different species of soil microfungi in one small forested area. Only painstaking laboratory work can give us even an idea of the distribution of some of the microfungi.

More visible fungi like mushrooms are difficult to locate as well. Mushrooms are only reproductive structures—the actual body of the fungus is out of sight within the soil. Because mushrooms are produced in response to climatic factors, it is possible that a certain fungus in a particular place will not produce a mushroom for years. Since the fungus cannot usually be found, let alone identified without its mushroom, you can see that the distribution and abundance of mushrooms do not necessarily reflect the distribution and abundance of mushroom-producing fungi. (One species of mushroom *has* been proposed to the federal government for listing, *Gloeocantharellus purpurascens.* It is known in two localities—one in the Great Smoky Mountains, and the other about 30 miles away in North Carolina.)

Rare mosses are usually those with very restricted habitats. An exaggerated example is the moss *Aschisma kansanum,* which is found only in Kansas, and there it grows only at the base of quartz pebbles. Most mosses are common in some parts of the country but rare in others, reflecting the size and distribution of their habitats. Therefore, a moss restricted to a particular habitat will be rare or abundant depending on the frequency of occurrence of that habitat. Preservation of a moss species can come about only through the preservation of its habitat. Because of their efficient means of dispersal and their good colonization ability, mosses frequently show good recovery when their habitat is restored.

Like mosses, a major cause for the rarity of lichens is restricted habitat. For example, *Umbilicaria caroliniana* is a widely distributed species with narrow habitat requirements. It is found only on small rock outcrops in the mountains of North Carolina, Alaska, Japan, and Siberia. But lichens are more threatened by destruction of formerly widespread habitats and, unlike mosses, are slow growers and slow to invade new or restored habitats. Some lichens, such as *Nephroma, Usnea,* and *Lobaria* that are characteristic of old forests, are becoming rare due to deforestation and aren't reappearing in second-growth stands. Draining marshlands has decimated many lichen populations. (The theory is that drainage decreases humidity and thus destroys habitats for many species.) Urbanization and its accompanying pollution are equally destructive. Lichens are extremely sensitive to air pollution. In a polluted environment lichens accumulate high levels of toxic substances, especially sulfur dioxide (SO_2) and heavy metals, which kill them. In fact, lichens are so sensitive that they are frequently used as monitors of pollution around power plants and cities.

According to one authority, the lichens of southern California's foggy, rocky coast are the most endangered. Many of the species originally discovered there are now extinct and their habitats destroyed.

A major cause for the rarity of freshwater algae is habitat destruction. Many of the rarer freshwater algae are found in shallow, clean, fast-moving streams—habitats which are disappearing rapidly in the East, especially through pollution and damming. An uncommon freshwater red (*Boldia erythrocyphon*) is restricted to fast streams in the southern Appalachians. It is an excellent indicator of water quality, occurring in and indicating what are commonly considered ideal trout streams. (*Boldia,* by the way, was found with

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Indiana

KNOBSTONE TRAIL (Washington County). The 1,051-acre area is part of a forested ridge-top which rises from 630 to about 960 feet above sea level and is Indiana's most prominent geologic feature. The area takes the name Knobstone since the soils have developed from materials weathered from shale, sandstone, and siltstone, commonly called "knobstone" shale. This is the key tract needed to complete the 75-mile-long Knobstone Trail, the state's first long-distance back-country trail. Management will be the responsibility of the Indiana Department of Natural Resources.

LAKETON BOG—Addition—(Wabash County). This 10-acre addition to a 30-acre quaking bog contains a stand of tamarack which is probably the southernmost occurrence in Indiana. Extensive sphagnum mats, poison sumac, red osier, pitcher plants, and several species of rare orchids are also present. This tract, along with the original gift of Ruth and Lee Brubaker, will be transferred to the State of Indiana to be managed as a Dedicated State Nature Preserve.

Maryland

CHOPTANK WETLANDS—Addition—(Talbot County). Located in the Choptank River Valley, upriver from the Conservancy's property at Frazier Neck, the 300-acre marshland is the Conservancy's second acquisition for the Choptank Wetlands assemblage. A prime habitat for black ducks, mallards, redwing blackbirds, and long-billed marsh wrens, the area is also used by migrating waterfowl as a feeding and resting place. The Easton Waterfowl Festival Committee is providing half the funds for the purchase. Management will be the responsibility of the Maryland Chapter.

Michigan

THREAD CREEK (Genesee County). Lying in the center of Grand Blanc, a suburb of Flint, this 40-acre woods with an abundance of wildflowers is being acquired for its open space value. A grant of $5,000 from the Grand Blanc Community Foundation and pledges of $100,000 from the community, coupled with $185,000 from the Land and Water Conservation Fund and Michigan Land Trust Fund, have enabled the Conservancy to purchase the area. The property will be transferred to the City of Grand Blanc for use as a park and natural area.

Minnesota

OTTERTAIL PRAIRIE (Ottertail County). The 320-acre preserve is a low, wet prairie lying in the Agassiz lake bottom. Composed of typical native

prairie species, including little and big bluestem, prairie dropseed, and many sedges, the prairie also has good populations of native forbs including cutleaf horehound, silver cinquefoil, and saline plantain. The property will be dedicated as a State Scientific and Natural Area and jointly managed by the Minnesota Chapter and the Minnesota Department of Natural Resources.

Missouri

BUFORD MOUNTAIN—Addition—(Washington County). Buford Mountain, of which this 30-acre property is a part, is recognized by a state-sponsored Natural Area Survey as an outstanding candidate for natural area preservation. The oak-hickory forest has a diverse understory development of flowering dogwood, redbud, wild plum, serviceberry, rusty black haw, red maple hawthorne, and farkleberry. The Missouri Chapter will manage the area in cooperation with the Missouri Department of Conservation.

MISSOURI PRAIRIE (Barton County). The gently rolling land is covered with vigorous stands of native grasses including big bluestem, broomsedge, and foxtail grass. Prairie chickens, white-tailed deer, and upland sandpipers live in the area along with various inhabitants of a prairie stream. The 980-acre area will become the core of the first Missouri Prairie State Park which will be managed by the Missouri Department of Natural Resources.

New York

MIANUS RIVER GORGE—Addition—(Westchester County). A gift of 8 acres from Mr. James Todd, Jr., the mixed hardwood forest with scattered hemlocks is contiguous to other parcels given to the Conservancy by Mr. Todd over the past ten years. The 372-acre preserve is the Conservancy's oldest active project and is managed by the Mianus River Gorge Committee.

NE-HA-SA-NE (Herkimer and Hamilton Counties). Predominantly forested with red spruce and balsam fir, this area in the central Adirondacks is summer home for bald eagles and is in the range of the golden eagle. The Beaver River flows across part of the 15,000-acre area which also contains three major brooks, bog communities, alder swamps, three lakes, and seven ponds. The largest lake, 1,440-acre Lake Lila, is dotted with seven forested islands. Several low elevation mountains (under 2,300 feet) give additional variety to the terrain. Now a part of the Adirondack Forest Preserve, the area is managed by the New York Department of Environmental Conservation.

Nanjemoy Creek

In February of 1945, a colony of great blue herons returning to their nests along Mattawoman Creek in eastern Maryland found only stumps where timberers had felled the last of the American beech, tulip poplar, and oak trees in which the birds had built a rookery. Ready to lay their eggs, the birds flew further into the woods to Nanjemoy Creek where they began to build again.

This February the herons again converged on Nanjemoy Creek, just 35 miles from Washington, D.C., and found the area just as they had left it last summer. Although the birds may not know it, the rookery and the 209 acres harboring it will be there again next year and every year, protected in perpetuity by The Nature Conservancy. A recent gift from Charles County Commissioner Eleanor Carrico provided an additional 50 acres in the direction in which the rookery seems to be drifting. Nanjemoy is the largest heron rookery in the Mid-Atlantic region, with 500 to 750 adult pairs building or refurbishing nests there each year.

The blue heron, largest wading bird on the east coast, stands four feet tall and has a wing span of six feet. Feeding primarily on aquatic prey, the great blues summer throughout the eastern U.S. and in southern Canada, and pass their winters from the Ohio Valley to Massachusetts and south to the Gulf of Mexico.

Because human intruders, however well-meaning, can cause the herons to abandon their nests, the Nanjemoy rookery will be closed to visitors pending further study. The Maryland Chapter, which has raised $135,000 for stewardship and purchase of the area, will manage the preserve.

THOUSAND ACRE SWAMP—Addition—(Monroe County). Another 10-acre addition to this exceptionally diverse wetland enlarges the preserve to 120 acres. One of the few undisturbed areas remaining in western New York, the swamp is home to the locally rare Massasauga rattlesnake. The Thousand Acre Swamp Committee of the Western New York Chapter manages the preserve.

North Dakota

TURTLE RIVER—Addition—(Grand Forks County). One of the few remaining wooded areas in the Red River Valley, the 170-acre parcel is adjacent to and will serve as buffer for Turtle River State Park. The North Dakota Parks and Recreation Department will manage the area.

Ohio

ABNER HOLLOW—Addition—(Adams County). The 115-acre parcel is part of an overall plan to link together the Ohio Chapter's Adams County preserves. The mixed hardwood, mixed mesophytic, and beech-maple forests are home to the federally endangered Indiana bat (*Myotis sodalis*) and the state endangered green salamander (*Aneides aeneus*), as well as the Rafinesquie's big-eared bat and the rough green snake. The area is to be transferred to the Cincinnati Museum of Natural History for management.

Oregon

ROCKAWAY OLD GROWTH FOREST (Tillamook County). The 50-acre spruce-hemlock forest and western red cedar swamp is a gift from the Publishers Paper Company, a subsidiary of the Times Mirror Company. One of the finest remaining cedar stands on the northern Oregon coast, the property supports trees ranging up to 15 feet in diameter. The forest floor is a thick layer of organic matter which could be useful in studies of tree regeneration or mineral cycling. Management of the property will be the responsibility of the Oregon Chapter.

Vermont

DEAD CREEK (Addison County). Some 50 acres of this 194-acre property support one of the few remnants of oak-hickory forest which, before timbering and grazing, was common in the Champlain Valley. White oak dominates the relict stand which also includes red oak, swamp white oak, and shagbark hickory. The property, adjacent to the Dead Creek Wildlife Management Area, will be transferred to the Vermont Agency of Environmental Conservation, Department of Fish and Game.

FRANKLIN BOG (Franklin County). The 83-acre acquisition is the first in a proposed assemblage of 150 acres at Franklin Bog, a National Natural Landmark. A small bog pond, ringed by a dense growth of sweet gale and leatherleaf, is surrounded by a 70 to 100-acre expanse of floating sphagnum mat. The mat merges into a drier black spruce-tamarack bog forest which changes on the outer perimeter of the bog to northern white cedar and red maple. Maleberry (*Lyonia ligustrina*) grows here in the northernmost extension of its range in Vermont along with pitcher plants, Arethusa orchids, cotton-grass, sheep laurel, and Labrador-tea. Cited in "Vermont Natural Areas, Report 2" as perhaps the finest example of an extensive quaking bog in northern Vermont, the area will be managed by the Vermont Chapter.

West Virginia

LEETOWN FISHERY (Jefferson County). Adjacent to the Leetown National Fisheries Center of the U.S. Fish and Wildlife Service, the 84-acre property has been identified by the West Virginia Heritage Program as a vitally important acquisition. An 8.6-acre portion of the property is marshland which provides habitat for pigeon hawk, spotted turtle, spring Blanchard's cricket frog, osprey, Virginia rail, king rail, and the eastern pipestrelle (bat), most of which are rare in West Virginia. The majority of the property is abandoned meadow and pasture land, critical buffer to the watershed which supplies the reservoir where the hatchery is located. The area will be transferred to and managed by the U.S. Fish & Wildlife Service.

OUTINGS PLANNED FOR 1979

The Nature Conservancy, for the third consecutive year, will sponsor tours to two fine natural areas. Four three-day trips will concentrate on the outstanding natural features of the Conservancy's Virginia Coast Reserve and the Adirondack Park in New York. The preserve tours, each of which can accommodate a group of 40 people, are scheduled for May 4-6 and October 12-14 to the Virginia Coast Reserve; and June 1-3 and September 28-30 to the Adirondack Mountain preserves.

For trip applications and additional details, please write to The Nature Conservancy Tours, P.O. Box 3611, Washington, D.C. 20007; or call 202/466-6307. Also, watch for further details in upcoming issues of the *News*.

(continued from page 26)

the snail darter in the Little Tennessee River.) *Nemalionopsis shawii,* previously known from the Philippines and Japan, has now been found in a branch of the Neuse River in North Carolina and a branch of Georgia's Broad River. It is also found with *Boldia.* Siltation because of construction near their habitats most threatens these two species. Because of their restricted nature, freshwater habitats are more endangered than marine, and effective preservation probably means protecting entire watersheds.

Because there are no barriers between marine habitats, habitat preservation is not sufficient for preserving marine algae. Protecting these species means controlling pollution. *Macrocystis,* the giant kelp of the west coast, is not rare, but its population is declining through harvesting and pollution. Endangered sea otters, whose numbers are just starting to increase, live in the kelp beds and eat the invertebrates that the beds support.

The rarity of lower plants appears largely to be the result of pollution, habitat destruction, and the very narrow environmental tolerances of many species. Preservation of mosses, fungi, algae, lichens, and liverworts can be accomplished only by pollution controls, habitat preservation, and public education. In many cases, the best way to identify lower plant habitats that are worth preserving may be to search for the best examples of aquatic and plant communities, rather than attempting the difficult and complicated task of identifying the lower plant species individually. Hopefully this type of "coarse filter" approach will prevent the extinction of many species through our ignorance of their distribution. As with the higher plants, we must preserve the maximum amount of diversity within the lower but not lowly plants.

Richard W. Goodspeed

It is with great sorrow that we announce the death of Richard W. Goodspeed, who for more than 10 years worked as a volunteer staff member in the Conservancy's Western Regional Office. A man of great integrity, patience, and business acumen, Dick was personally responsible for acquiring and preserving for posterity many remnants of California's rich natural heritage. Most notable was his role in establishing the Elkhorn Slough Preserve, which in the years to come will stand as a testimony to his foresight and dedication.

QUEEN CITY RETREAT

The site of the 1979 Nature Conservancy Annual Meeting, Cincinnati, Ohio, is often called the "Cradle of Geologists." Ancient fossil limestone deposits and beds, which have been uplifted and eroded by time, streams, and by glacial movements, form a magnificent landscape of hills, valleys, and winding rivers. Cincinnati's natural history is rich; in fact, the downtown area is located on the outwash plain formed by the melt of the last glacial retreat, which occurred approximately 20,000 years ago. That cold glacial climate fostered the growth of coniferous forests, more typical of many parts of Canada. Further climatic changes caused the "prairie peninsula" of the midwest to extend into Ohio, bringing about a proliferation of diverse mesophytic hardwood forests.

Cincinnati's Netherland Hilton Hotel will house Annual Meeting participants and will be the site of most of the Meeting's events. After the Open Board Committee Meetings on Thursday, September 20, members will be welcomed that evening at the Cincinnati Museum of Natural History for the Opening Reception. The museum will feature a nature walk exhibit highlighting Conservancy preserves and a show by nature artist John Ruthven.

Friday will feature the business meeting, followed by field trips to Boone Cliffs, the Cincinnati Nature Center, and Northside Woods. There will also be seminars and workshops, and canoe floats down the Little Miami Scenic River. That evening members may enjoy a relaxing dinner while cruising down "la Belle Riviere"—the Ohio River.

Half-day and full-day tours are planned for Saturday, featuring Cedar Bog, Kroger Hills, Kentucky bluegrass country, and cultural tours of the Queen City. The Conservancy's regional receptions followed by the Annual Awards Dinner will take place that evening. Though the dinner will officially end the 4-day meeting, a few half-day tours near Cincinnati will be offered on Sunday morning. Post-conference trips, also beginning on Sunday morning and returning to Cincinnati on Monday, September 24, will highlight the Red River Gorge in Kentucky, an overnight stay at the Natural Bridge State Park, and the Edge of Appalachia Preserves in Adams County.

Please look for further details and registration information on the Conservancy's 1979 Annual Meeting in the May/June issue of the *News.*

PHOTOS: Morgan A. Bondy, p. 20; Susan Bourque, p. 15; Michael P. Gadomsky, p. 27; Michael Godfrey, p. 21 center; Luther Goldman, p. 28; Mary Hochberg, p. 13 bottom; William Justice, pp. 22, 24 top; Warren Keammerer, inside front cover; Tim Loomis, p. 16; Ken Moore, pp. 21, 23, 24 bottom; James Reveal, p. 5; L. Smith, p. 14; R. Scott Spann, p. 18; W. Daniel Svedarsky, p. 13 top.

NEW LIFE MEMBERS

An individual becomes a Life Member of The Nature Conservancy upon contribution of $1,000 for membership dues.

Mr. A. Watson Armour III
Illinois

Dr. Frank C. Bender
Illinois

Mr. Albert E. Bonte
Rhode Island

Mrs. Virginia T. Brown
Florida

Dr. Charles E. Crandall
New Jersey

Mrs. Franz Denghausen
Massachusetts

Mr. Richard F. Dopler
Florida

Ms. Mabel A. Foisie
Washington

Mr. Stephen H. Forbes
Pennsylvania

Mrs. Lynn Crosby Gammill
Mississippi

Dr. Frederick Goldman
Ohio

Mrs. Kathryn Craig Henry
Tennessee

Mr. William H. Hobart
Ohio

Ms. Margaret B. Huffman
California

Mrs. Howard James
Arizona

Mrs. John McBryan
California

Mr. Howard L. Nicholson
California

Mr. William Pagenstecher
Missouri

Mr. Charles E. Roos
Tennessee

Mr. C. Burton Sharp
Wyoming

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